THE TRILOBITE *PLIOMERINA* CHUGAEVA FROM THE ORDOVICIAN OF NEW SOUTH WALES

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ABSTRACT. Two new pliomerid species, *Pliomerina austrina* and *P. prima*, are described from Ordovician limestones of New South Wales. The well-preserved, silicified material reveals new information about the nature of the genus and its relationships. Representatives of *Pliomerina* have been described and illustrated previously only from China, Korea, and Kazakhstan. The Australian and Asian occurrences suggest a close faunal connection during Gisbornian and Eastonian (about Lower–Middle Caradocian) time.

WITH the possible exception of fragmentary asaphids, the most common trilobites in the Ordovician limestones of central-western New South Wales are pliomerids identified as belonging to the genus *Pliomerina* Chugaeva. While other elements of the fauna exhibit North American relationships, *Pliomerina* establishes a linkage with Asian faunas (Packham 1967). The type species, *Pliomerina martellii* (Reed), is described from the Upper Llanvirnian? of Yunnan, China (Reed 1917), and a form seeming to bear affinities to it is recorded from the Tsiubon Limestone (Lower Caradocian) of South Korea (Kobayashi 1934). Three species have been described by Chugaeva (1958) from the Ordovician of Kazakhstan, U.S.S.R., *P. sulcifrons* (Weber) from the Anderken horizon (Lower Caradocian), *P. unda* Chugaeva from the Otar horizon (Middle Caradocian), and *P. dulanensis* Chugaeva from the Dulankarin horizon (uppermost Caradocian to lowest Ashgillian). Whittington (1966) has reported the genus from the Gordon Limestone of Tasmania, and has taken it to be a representative of the Caradocian fauna.

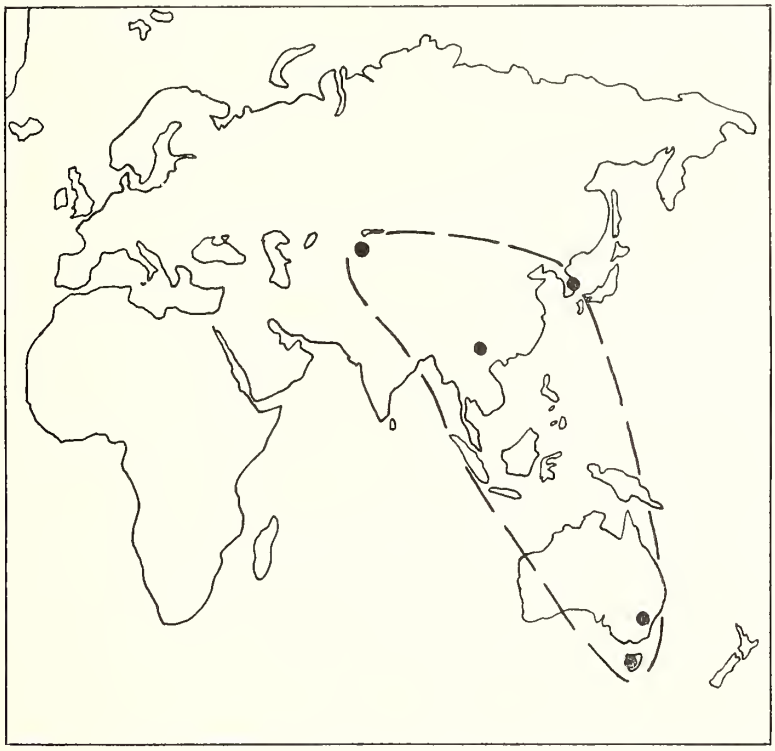
The Ordovician successions containing *Pliomerina* and other trilobites in central-western New South Wales appear to be broadly of Caradocian (Gisbornian–Eastonian) age. The trilobite-bearing beds seem to be of post-*Nemagraptus gracilis* age, and may be as young as the Zone of *Dicranograptus hians* (i.e. Upper Eastonian). For discussion of age and correlation of the deposits, see Packham (1969), Webby (1969), and Moors (1970). In the lower part of the Cliefden Caves Limestone, *Pliomerina prima* sp. nov., and unidentified asaphids are the most abundant trilobites. Less common forms include *Remopleurides* sp., *Eobronteus* sp., and a trinucleid, probably a species of *Parkesolithus* Campbell and Durham. In the upper part of the Cliefden Caves Limestone, *Pliomerina austrina* sp. nov., *Parkesolithus* sp., and fragmentary asaphids are represented. The overlying Malongulli Formation at Trilobite Hill and nearby Copper Mine Creek has produced *Malongullia oepiki* Webby, Moors, and McLean, *Encrinuraspis optimus* Webby, Moors, and McLean, *Parkesolithus* sp., *Remopleurides* sp., *Eobronteus* sp., and asaphid fragments. *Encrinuraspis optimus* has also been recorded from the Malongulli Formation of the Regan's Creek area (Webby, Moors, and McLean, 1970).

The Bowan Park Limestone contains *Pliomerina prima* sp. nov. in the lower part, *P. austrina* sp. nov., *Parkesolithus* sp., *Amphilichas* sp., an encrinurid, possibly an *Encrinuraspis*, and fragmentary asaphids in the middle part, and a trinucleid, an illaenid, and indeterminate asaphids at the top of the succession. A species of *Parkesolithus* has also been found by Mr. M. Tuckson in shales (possibly equivalent in age to the Malongulli Formation) north of Cheeseman's Creek, 16 miles west of Orange.

[Palaeontology, Vol. 14, Part 4, 1971, pp. 612–622, pls. 114–115.]

Ordovician limestones at Billabong Creek have yielded an abundant silicified fauna including *Pliomerina austrina*, and less common *Remopleurides* sp., *Amphilichas* sp., *Sphaerocoryphe* sp., *Parkesolithus* sp., an encrinurid, probably an *Encrinuraspis*, and fragmentary asaphids. Campbell and Durham (1970) have described *Parkesolithus gradyi* from unnamed siltstones overlying the limestone near Billabong Creek.

Of these forms, *Malongullia*, *Encrinuraspis*, and *Parkesolithus* seem to be endemic genera to Australia. *Pliomerina* has a restricted distribution in Australia and Asia (text-fig. 1), and *Remopleurides*, *Sphaerocoryphe*, *Eobronteus*, and *Amphilichas* appear to have more cosmopolitan relationships, since they are found also in North America,



TEXT-FIG. 1. Map showing known occurrences of the genus *Pliomerina*, and possible limits of the *Pliomerina* fauna in Middle–Upper Ordovician time.

Europe, and Asia. The New South Wales fauna thus seems to comprise an admixture of Whittington's (1966) Caradocian 'northern region' fauna (with *Remopleurides*, *Sphaerocoryphe*, and *Amphilichas*) and his 'southern region' or '*Encrinurella*' fauna (with *Pliomerina*). Since the genus *Encrinurella* Reed has not been confirmed in Australian 'Caradocian' successions, it is suggested that the faunal province bearing its name, extending from Kazakhstan, China, South Korea, Thailand, North Vietnam, and possibly the Himalayas to New South Wales and Tasmania, be renamed the *Pliomerina* fauna (text-fig. 1).

Pliomerids have been reported from a number of other parts of Australia, and seem to indicate that the family was well represented in the region throughout the Ordovician.

The genus *Protopliomerops* Kobayashi is recorded from the Digger Island Formation (Lancefieldian or Tremadocian) at Waratah Bay, Victoria (Singleton, *in* Lindner 1953), and a species of *Pliomerops* Raymond is listed as coming from the Caroline Creek Sandstone and the Florentine Valley Mudstone (Middle–Upper Arenigian) of Tasmania (Banks 1962). Undescribed pliomerids have also been mentioned as occurring in the Ordovician section of Samphire Marsh No. 1 Well on the southern side of the Canning Basin, Western Australia (Gilbert-Tomlinson 1961). These have been considered by Gilbert-Tomlinson to have a late Tremadocian–Arenigian age. Others have been reported from Western Australia, in the upper part of the Emanuel Limestone and in the Gap Creek Dolomite near Fitzroy Crossing, in beds broadly ranging from Llanvirnian to Caradocian in age (Guppy and Öpik 1950), and from the Lower Ordovician of the Cambridge Gulf area (Öpik 1957).

SYSTEMATIC DESCRIPTIONS

Family PLIOMERIDAE Raymond 1913

Genus PLIOMERINA Chugaeva 1956 (= *Pliomeraspis* Harrington 1957)

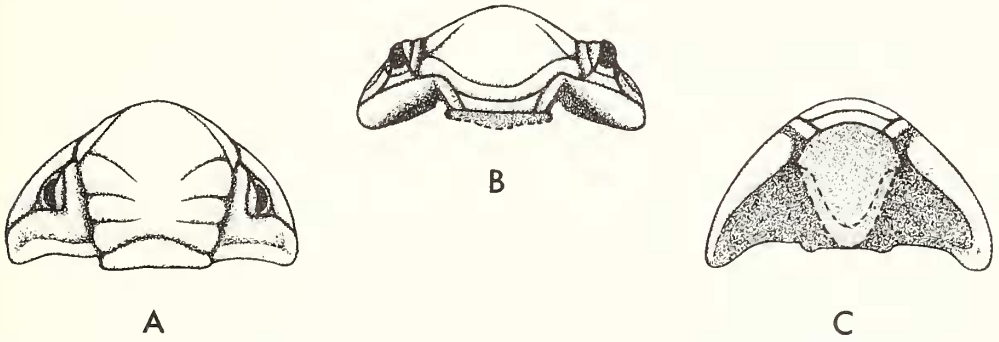
Type species. Pliomera martellii Reed 1917.

Diagnosis. Glabella forwardly expanding, with large frontal lobe and three lateral lobes; lobe *3p* longer (exsag.) than lobes *1p* or *2p*; lateral furrow *3p* intersecting preglabellar furrow at or just in front of antero-lateral angle of glabella; lateral parts of anterior border exhibited on dorsal side but flexed to slope downwards and backwards sagittally; relatively broad (tr.), trapezoidal, posteriorly narrowing rostral plate, with maximum width slightly more than one-half greatest width of glabella; eye lobe prominent, situated with mid-point on about same transverse line as lateral furrow *2p*, only short distance out from axial furrow; genal angle in mature stage rounded; hypostome typically pliomerid with rounded, tongue-like posterior margin; ten thoracic segments in one species; pygidium of *Pliomerella* type with axis of five rings and large terminal piece; five pairs of pleurae with moderately blunt, rounded ends and deeply impressed, backwardly curving interpleural furrows; tips of pleurae fused and curved under to form doublure.

Discussion. Reed (1917) based the description of *Pliomera martellii* on two incomplete cranidia from the Llanvirnian? of Pupiao, Yunnan, China, observing that the true affinities of the species were somewhat uncertain. He noted the unusual feature of the species, namely the occurrence on the frontal lobe of 'a pair of small marginal notches on its anterior edge'. Chugaeva (1956, 1958) designated Reed's species the type species of her new genus *Pliomerina*. She emphasized the occurrence in the frontal part of the glabella of the two 'prefrontal furrows' (Reed's 'marginal notches') which separate the two small, lateral 'prefrontal lobes' from the much larger, medial frontal lobe. It is now clear from study of well-preserved, silicified Australian material that Chugaeva was incorrect in interpreting the lateral 'prefrontal lobes' as part of the glabella. In fact the 'prefrontal furrows' prove to be lateral portions of the preglabellar furrow, and the 'prefrontal lobes', lateral portions of the anterior border. However, despite her misinterpretation, the genus *Pliomerina* remains valid and distinct from all other pliomerids.

The cephalon of *Pliomerina* is perhaps nearest to that of *Pliomerops*, a widespread genus from the Middle–Upper Ordovician of North America, Europe, and Asia. The type species, *P. canadensis* (Billings), however, has a relatively narrower, straight-sided glabella, a relatively much narrower (tr.) and longer (sag.) rostral plate, a much smaller frontal lobe with lateral furrow *3p* usually further forward, and it has eye lobes placed considerably further out from the axial furrow (Whittington 1961; Shaw 1968). Furthermore, *Pliomerops* has a quite different thorax with 14–19 segments, and pygidium with a short, triangular terminal axial piece.

The genus *Pliomerella* Reed (type species *P. serotina* Reed) from the Middle–Upper Ordovician of Scotland, Virginia, and north-eastern U.S.S.R. has a similar pygidium to *Pliomerina* with five axial rings, a large sub-rectangular to slightly tapering terminal axial piece and five pleurae (Cooper 1953). However, the glabella of *Pliomerella* is markedly different, with only two pairs of lateral furrows (Reed 1941), and the thorax consists of 19 segments (Cooper 1953).



TEXT-FIG. 2. Diagrams of the cephalon of the holotype of *Pliomerina austrina* sp. nov.; A, dorsal view, B, anterior view, C, ventral view; ×6. Note inferred position of hypostome (lightly stippled and outlined by dashed lines) in anterior and ventral views.

Pliomerina austrina sp. nov.

Plate 114, figs. 1–28; Plate 115, figs. 1–12; text-fig. 2

Material. Holotype (SUP 22940) and thirty-seven paratypes (SUP 22941–49, 23900–06, 23921–41) from Ordovician limestone at Billabong Creek. Also paratypes from the upper part of the Cliefden Caves Limestone at Trilobite Hill (SUP 13908) and Licking Hole Creek (SUP 23943), and from the middle part of the Bowan Park Limestone at Quondong (SUP 23907). Registration numbers of specimens in the palaeontological collections of the Department of Geology and Geophysics, University of Sydney.

Diagnosis. Species of *Pliomerina* with relatively broad glabella; lateral furrows extending inwards to slightly more than one-third of glabella width (tr.); furrow *3p* intersects preglabellar furrow well in front of antero-lateral corner of glabella; lobes *1p–3p* subequal in length (exsag.) at inner ends of furrows; mesial tubercle on occipital ring usually absent, though may be developed as tiny tubercle on small individuals; bluntly rounded and fused outer ends of pleurae on pygidium; dorsal surface of cephalon, thorax, and pygidium, and ventral surface of hypostome smooth to irregularly finely granulated.

Description. Cephalon sub-semicircular in outline, transversely and sagittally gently convex. Glabella sub-pentagonal; widest across lateral lobes *3p*, narrows gradually backwards to occipital ring, delimited by deep, relatively broad axial furrows, and narrows more abruptly forwards. Occipital furrow deep, running in gentle curve convex forward. Axial furrows and occipital furrow form broad, raised ridges on undersurface. Three relatively narrow lateral glabellar furrows, not deeply impressed except at outer ends, extending to one-third or just more than one-third of glabella width; furrow *1p* transversely directed with very slight forward curve at inner end; furrow *2p* transversely directed with slightly backwardly curved inner end; and furrow *3p*, which commences at preglabellar furrow a short distance in front of antero-lateral corner of glabella, inclined inward and backward at angle of about 50° to axis. Lobes *1p*, *2p*, and *3p* subequal (exsag.) at inner ends; however, lobes *1p* and *3p* expand laterally, giving club-shaped form, whereas lobe *2p* has almost straight sides or even tapers slightly laterally; consequently, towards outer ends, lobe *3p* is longer (exsag.) than lobe *1p*, and lobe *1p* is longer than lobe *2p*. Lateral glabellar furrows form only shallow ridges on undersurface, dying out inwards (Pl. 114, fig. 6; Pl. 115, fig. 8). Preglabellar furrow shallow except at intersection with axial furrow, in anterior view (Pl. 114, fig. 3; text-fig. 2B) its course curves gently down to mid-line from more sharply up-arched lateral ends; in large specimen (Pl. 115, fig. 2), smooth downward curve of preglabellar furrow disrupted by sharp nick a short distance away from mid-line, giving rise to very short, tongue-like mesial extension of frontal lobe. Frontal lobe relatively large, slightly longer (sag.) than total projected length (sag.) of lateral lobes; slightly wider (tr.) than long (sag.). Anterior border broader than glabella, and short (exsag.); longer laterally than mesially; bounded laterally by anterior end of axial furrow and anterior branch of facial suture; only outer parts exhibited on dorsal surface, arched downward and backward sagittally (text-fig. 2C). Prominent anterior boss situated on ridge-like undersurface of axial furrow at mid-point between front and back lateral extremities of anterior border (Pl. 115, fig. 8). Rostral plate trapezoidal, short (sag. and exsag.), and having maximum width just more than one-half maximum width of glabella, narrowest at posterior margin; defined laterally by faint, short connective sutures and anteriorly by faint rostral suture; limited posteriorly by deeply impressed medial portion of hypostomal suture (Pl. 115, fig. 6; text-fig. 2B–C).

Cheek sub-triangular, gently convex, sloping moderately steeply outward and forward; posterior and lateral border furrows prominent. Fixed cheek L-shaped, narrowing anteriorly. Eye lobe relatively large, raised, subrounded, situated short distance out from axial furrow, with mid-point in about same transverse line as lateral furrow *2p*; length (exsag.) just less than one-third of length (sag.) of glabella; curved visual surface slopes steeply outward, presumably thin and consequently not pre-

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EXPLANATION OF PLATE 114

Figs. 1–28. *Pliomerina austrina* sp. nov. 1, from upper part of Cliefden Caves Limestone, Trilobite Hill, 2–28, from Ordovician limestone at Billabong Creek. 1, dorsal view of relatively small specimen with incomplete cephalon, thorax of 10 segments, and pygidium; paratype SUP 13908, ×5. 2–7, dorsal, anterior, oblique antero-lateral, ventral, ventral (reversed aspect), and posterior views of cephalon of holotype SUP 22940, ×5. 8–11, dorsal, posterior, lateral, and anterior views of pygidium of paratype SUP 22942, ×4. 12, dorsal view of incomplete cephalon and 7 thoracic segments; paratype SUP 22941, ×5. 13–14, dorsal and ventral views of pygidium of paratype SUP 22943, ×4. 15–16, anterior and ventral views of moderately large, incomplete hypostome; paratype SUP 23903, ×4. 17–19, oblique, lateral, and ventral views of hypostome; paratype SUP 23904, ×5. 20, dorsal view of small pygidium; paratype SUP 23906, ×5. 21, oblique view of enrolled exoskeleton, showing incomplete cephalon and thorax; paratype SUP 23902, ×3. 22–24, anterior, posterior, and dorsal views of thoracic segment; paratype SUP 22946, ×4. 25, view of undersurface of thoracic segment of paratype SUP 22946, ×8. Note panderian notch. 26, oblique posterior view of incomplete pygidium showing cut-a-way with inturned posterior margin forming doublure; paratype SUP 22944, ×4. 27, ventral view of articulated thoracic segments of paratype SUP 22945, ×4. 28, detailed view of undersurface of thoracic segments of paratype SUP 22945, ×8 (anterior to right side). Note slot-like opening in inner part of pleura, raised anterior area and flat, posterior articulating facet in doublure of outer part of pleura.


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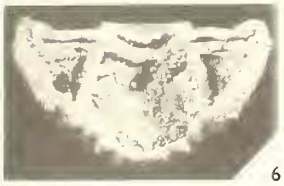
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served; palpebral lobe moderately broad, slightly raised, bounded on inside by deep palpebral furrow which extends forward to intersect anterior part of suture obliquely, opposite lateral lobe *3p*, and to rear curves sharply outward to meet posterior part of suture (Pl. 115, fig. 7). Posterior border gently inclined and convex, becoming steeply inclined and expanding (exsag.) distally; posterior furrow deep and broad, becoming less strongly impressed distally, and eventually dying out just inside margin; genal angle rounded, in smaller specimens more sharply rounded; doublure extends inwards from genal angle to fulcrum beneath posterior border. Anterior branch of suture runs forward from eye lobe, intersects anterior end of axial furrow, then turns sharply inward and extends along outer edge of anterior border to junction with rostral and connective sutures, at a point approximately half the distance (measured around margin) from lateral end of anterior border to mid-line. Posterior branch of suture swings sharply outward on posterior side of eye lobe, intersects palpebral furrow, and then continues outward and backward across lateral border, reaching margin a short distance in front of genal angle. Lateral border moderately convex, sloping steeply, broad (as seen in lateral aspect), almost keel-like posteriorly, becoming narrower (in lateral view) with complementary increase in width of doublure anteriorly; deeply impressed antennular notch on doublure of anterior part of lateral border, with only short, curved flange of lateral border extending forward of antennular notch to abut against rostral plate; this flange together with rostral plate and sagittal portion of anterior border comprise anterior part of doublure (Pl. 114, figs. 5–6; text-fig. 2c). Lateral furrow deeply impressed, extending from intersection with posterior branch of suture forward along lateral border, becoming confluent with anterior branch of suture between lateral and anterior borders. Portion of eye on free cheek includes broad, steeply inclined eye socle surmounted by visual surface; bounded by gently curved, firmly impressed furrow which extends forward and inward, confluent with anterior end of palpebral furrow at its point of junction with anterior branch of suture, and backward and inward to again come into confluence with palpebral furrow and posterior branch of suture (Pl. 115, fig. 4). Occipital ring long sagittally, gently convex and slightly elevated above adjacent posterior borders; usually smooth (Pl. 114, fig. 12; Pl. 115, fig. 1) but in few, small specimens possesses tiny mesial tubercle (Pl. 115, fig. 10); occipital furrow which curves convexly forward is not strictly confluent with posterior border furrow; posterior margin of occipital ring straight; doublure of occipital ring moderately long, almost reaching forward to occipital furrow (Pl. 114, fig. 6); apodemes only weakly developed on inside of lateral ends of occipital furrow.

Gently convex median body of hypostome, widest in line with anterior wings, narrows backward; posterior border almost flat passing anteriorly into gently convex, narrower lateral border with more deeply impressed border furrow which curves sharply outwards opposite anterior wing. Posterior margin smooth, tongue-like in outline; anterior margin weakly prow-shaped; weakly developed lateral bulges merge with median body just in front of anterior wings; anterior wings long, upwardly and slightly outwardly directed (upper ends poorly preserved); deep lateral notch directly behind anterior wing, with weak, angulate shoulder below, projecting into short, inward and backwardly directed posterior wing. One specimen shows fragment of hypostome attached by hypostomal suture to rostral plate and anterior end of lateral border (Pl. 115, figs. 4 and 6), and rod-like structure extending downward and inward from anterior boss, presumably representing fused broken piece of anterior wing (Pl. 115, fig. 5). Hypostome seems to be firmly linked by hypostomal suture to rostral plate and anterior part of lateral border.

Thorax of ten segments in one specimen (Pl. 114, fig. 1); width diminishing gradually backwards; one and three-quarter times length of cephalon; axis about one-third total width of thoracic segment, transversely convex; defined by very deep, relatively broad, slot-like axial furrows; articulating furrow straight in vertical plane, moderately deep, narrow and rather sharply impressed, especially distally, with development of pair of relatively large apodemal pits; apodemes only weakly developed beneath. Articulating half ring moderately long sagittally, inclined upwards and forward on to what appears to be crest-like ridge, becoming shorter, and inclined obliquely forward and outward, and with ridge appearing to die out laterally; articulating half ring only projects short distance forward of ridge; ridge in close contact with doublure of axial ring. Axial ring consists of convex (sag.) posterior part, separated from relatively flat (sag.) anterior part by shallow furrow, curving convexly backward; posterior part of axial ring widest and highest, and shorter sagittally than laterally; anterior part of axial ring becomes shorter (exsag.) laterally, and narrower (tr.) than posterior part; posterior margin of axial ring reflected as doublure, extending from posterior side slightly more than one-third distance forward

beneath axis. Posterior surface of axial ring flattened with relatively expanded, flat lateral areas and finely sculptured ridge arching across mid-line (on lower edge) and down to ring processes (on inner edges); confluent with posterior flanges of pleurae.

From deep, slot-like axial furrow to fulcrum, pleura gently convex (exsag.) and gently inclined outwards; undersurface flat and horizontal with wide, straight-sided cavity (deepest proximally); sharply flexed at fulcrum, with outer part of pleura moderately steeply inclined (about 30° from vertical); outer part of pleura gently convex (exsag.), curved gently forward (concave forward) and may be slightly expanded (exsag.), paddle-like; terminations rather blunt distally but with small, anteriorly directed tips. Doublure extends from distal end to fulcrum. Articulating ledges extend to fulcrum along lower, horizontal edge of pleura; straight, transverse, ridge-like anterior flange and groove-like posterior flange. Ring process (posterior side) and socket (anterior side) situated on outer and lower edge of axial ring with adjacent, smaller axial socket (posterior) and process (anterior) on line with axial furrow. At fulcrum, fulcral process (anterior) and socket (posterior) developed, with smaller secondary process below fulcral socket, and complementary secondary socket below fulcral process. Similar articulating structures formed on posterior surface of cephalon and anterior end of pygidium. Straight hinge line with flanges and points of articulation on inner pleura and outer margin of axial ring remaining in contact on enrolment or in extended position. Pleural furrows not developed. Outer part of first thoracic segment during enrolment fits beneath posterior border and genal angle of cephalon (Pl. 114, fig. 21). In succeeding segments break-in-slope on outer part of pleura between flat, anterior, sub-triangular articulating facet and more convex, outwardly tapering posterior region, with complementary break-in-slope imprinted on doublure separating gently raised triangular-shaped anterior region from posterior articulating facet; outer, anterior articulating facet slides beneath inner posterior articulating facet of preceeding pleura (Pl. 114, figs. 13 and 17), and break-in-slope acts as stop during enrolment. Outer parts of thoracic segments do not become exposed even in extended position owing to longer (exsag.) convex and facet-like areas. Keyhole-like panderian notch extends into doublure between raised anterior and posterior flanges of fulcral articulating structures (Pl. 114, fig. 25); anterior flange (= anterior edge of panderian notch) does not appear to act as stop in enrolment.

Pygidium sub-pentagonal, gently convex (strongly convex in region of postero-lateral margin); about equal to cephalon in length. Axis tapering posteriorly, with five axial rings, and large, slightly tapering terminal piece of length (sag.) equivalent to 4–5 axial rings; anterior end of terminal piece may exhibit faint, paired lateral bulges; backward taper of terminal piece gradual until near posterior margin, where apex narrowly rounded; anterior rings slightly bowed forwards. Axial furrow deeply impressed over most of length (exsag.) of pygidium but curves slightly inwards against terminal piece and dies out close to posterior margin. Ring furrows deep, rather sharply impressed. Five gently raised, unfurrowed pleurae corresponding to (though posteriorly not strictly confluent with) axial rings, sharply downflexed distally; deep, sharp interpleural furrows, arcuate, widening slightly, becoming progressively more posteriorly directed backwards, and shorter, with last pair shortest and orientated directly backwards alongside terminal piece, coming into contact just behind terminal piece on posterior border (Pl. 114, fig. 9). First pleural ridge exhibits rather abrupt flexure between inner and outer parts, coinciding with fulcrum of preceding thoracic pleura; in larger specimens (Pl. 114, fig. 10) outer part of first pleura has facet, appearing to show some wear from movement of preceding thoracic pleura over it. Ends of pleurae bluntly rounded, fused and only projecting slightly outward; extending into pygidial doublure of ventral surface (Pl. 114, figs. 14 and 26) to fulcrum at anterior end, and to one-third length of terminal piece posteriorly. No spines.

Surface of exoskeleton mainly smooth, though scattered granules of variable size may be seen on frontal and lateral glabellar lobes, anterior and lateral borders and fixed cheek (Pl. 115, fig. 12), on median body of hypostome, on dorsal, anterior, and posterior surfaces of thoracic segments, and on dorsal surface and postero-lateral margin of pygidium of well-preserved specimens.

Largest glabella (SUP 23939) has maximum width of 9 mm. It is estimated that this particular form would have had a maximum width across cephalon of about 18 mm, and an overall length (sag.) of about 36 mm. Other large specimens (SUP 23901, 23927) have glabella width of 7·4 mm and length (sag.) of cranidia of 8·5 mm. Holotype has cephalon width of 7·0 mm, glabella width of 3·6 mm, and length (sag.) of cranidium of 4·1 mm. Smallest cranidia in collection, presumably representing small holaspides, have length (sag.) of just over 2·3 mm and glabellar width of 2 mm (Pl. 115, fig. 10).

Remarks. The type species, *Pliomerina martellii* (Reed) from the Middle Ordovician of Yunnan, China, differs from *P. austrina* sp. nov. in having shorter (tr.) lateral glabellar lobes and furrows, the lateral furrow *3p* intersecting preglabellar furrow almost at junction with axial furrow and in line with maximum width of glabella, a pair of short, curved grooves on surface of frontal lobe towards mid-line, and a slightly more prominent mesial tubercle on occipital ring (Reed 1917). Of the species from Kazakhstan, *P. sulcifrons* (Weber) from the Lower Caradocian has the lateral furrow *3p* also intersecting preglabellar furrow near junction with axial furrow, shorter and straighter lateral furrows, and seemingly a shorter (exsag.) lateral lobe *1p*. *P. unda* Chugaeva from the Middle Caradocian has a relatively narrower glabella, the lateral furrow *3p* intersects at or very near junction of preglabellar and axial furrows, and the lateral lobe *1p* is short (exsag.), especially at inner end. The uppermost Caradocian to lowest Ashgillian species, *P. dulanensis* Chugaeva, differs in having a relatively wider and blunter frontal lobe, a very short (exsag.) lateral lobe *1p* and an almost rectangular terminal axial piece on the pygidium (Chugaeva 1958).

Pliomerina prima sp. nov.

Plate 115, figs. 13–29

Material. Holotype (SUP 23908) and five paratypes (SUP 23909–13) from the 'brachiopod unit' in the lower part of the Bowan Park Limestone 1½ miles north-east of Quondong. Also paratypes from the lower part of the Cliefden Caves Limestone at Fossil Hill (SUP 23914–20, 23944–49, 24900–03). Numerous other fragmentary specimens have been collected from the lower part of the limestone at Fossil Hill.

Diagnosis. Species of *Pliomerina* with lateral glabellar furrow *3p* intersecting preglabellar furrow a short distance in front of antero-lateral corner of glabella; lateral furrow *1p* sharply concave forward at inner end; length (exsag.) across club-shaped lateral lobe *1p* at inner ends of furrows much less than across lobes *2p* or *3p*; development of moderately prominent mesial tubercle of occipital ring, even on larger specimens; bluntly pointed free ends of pleurae on pygidium; more conspicuous and even fine granulation, especially on free cheeks, hypostome and pygidium.

Description. Cephalon sub-semicircular; gently convex in both directions, except for moderately convex frontal part of glabella sagittally. Glabella subpentagonal, relatively broad, with widest part towards front end of lateral glabellar lobes *3p*, narrows gradually back to occipital ring; bounded by deep, broad axial furrows. Occipital furrow deep, broad, bowed forwards. Lateral furrows become more deeply impressed at outer ends, extending to slightly more than one-third of glabella width; furrow *1p* slightly backwardly directed with strong forward bend at inner end; lobe *1p* with markedly club-shaped form and very narrow (exsag.) inner end; furrow *2p* transverse to slightly backwardly directed, subparallel to furrow *1p*, bounding almost straight-sided lobe *2p*; furrow *3p* inclined more strongly backwards at angle of about 50° to axis, and commences at preglabellar furrow just in front of antero-lateral corner of glabella; maximum length (exsag.) of lobe *3p* (measured across outer expanded part) slightly greater than lobe *1p* and much greater than lobe *2p*. Preglabellar furrow shallow except at distal ends, curved downward across sagittal region and up-domed laterally. Frontal lobe relatively large, subequal to (projected) length (sag.) of lateral lobes *1p–3p*, and wider than long (sag.). Anterior border slightly wider than glabella, short (slightly shorter medially than laterally); only outer parts seen in dorsal view, inner, sagittal part reflected downwards and backwards (Pl. 115, figs. 17 and 19). Undersurface of axial and occipital furrows form strong ridges; prominent anterior boss beneath anterior end of axial furrow, midway between front and back lateral extremity of anterior

border; lateral glabellar furrows only faintly impressed on undersurface. Occipital ring gently convex with centrally placed mesial tubercle (most prominent in small specimens) and straight posterior margin. Doublure of occipital ring reaches forward to occipital furrow.

Cheek subtriangular, sloping gently outward and forward, with conspicuous eye lobe and posterior and lateral furrows. Eye lobe relatively large, raised, situated just out from axial furrow, and having mid-point in similar transverse line to lateral furrow *2p*; length (exsag.) just more than one-third length (sag.) of glabella; steep, outwardly curved eye surface not preserved; palpebral lobe moderately broad, tapering anteriorly and posteriorly, convex in exsagittal line; deep palpebral furrow runs longitudinally along inner margin of palpebral furrow, curving at anterior and posterior ends to be confluent with furrow bounding eye socle of free cheek. Anterior branch of facial suture runs forward from eye lobe, intersects anterior end of axial furrow and curves sharply inward and forward to pass between anterior border and lateral border; posterior branch swings abruptly outward on posterior side of eye lobe, and runs outward and backward across lateral border, intersecting margin just in front of genal angle. In large specimens genal angle is rounded (SUP 23920), but in smaller specimens posterior border is elongated into short genal spine (Pl. 115, figs. 16–19). Deep, posterior furrow not strictly confluent with occipital furrow, dying out laterally. Posterior border expanding (exsag.)

EXPLANATION OF PLATE 115

Figs. 1–12. *Pliomerina austrina* sp. nov. 1–8, 10–12, Ordovician limestone at Billabong Creek. 9, middle part of Bowan Park Limestone at Quondong. 1–2, dorsal and anterior views of large incomplete cephalon of paratype SUP 23901, ×4. Note prominent nicks in preglabellar furrow to either side of mid-line and fine granular ornament. 3, dorsal view of 5 thoracic segments of paratype SUP 22949, ×4. 4–6, oblique lateral, ventral and oblique anterior views of incomplete cephalon showing prominent eye and small fragment of hypostome attached by hypostomal suture to rostral plate and anterior part of lateral border, and downward extension from anterior boss; paratype SUP 22948, ×4. 7, oblique anterior view of incomplete cephalon of paratype SUP 22947, ×4. 8, ventral view of paratype SUP 23932 showing anterior boss, ×4. 9, dorsal view of rather smooth, incomplete pygidium; paratype SUP 23907, ×4. 10, dorsal view of small incomplete cephalon with tiny mesial tubercle on occipital ring; paratype SUP 23905, ×5. 11, dorsal view of small pygidium of paratype SUP 23900, ×5. 12, detail of antero-lateral part of cephalon to show ornamentation; paratype SUP 23932, ×10.

Figs. 13–29. *Pliomerina prima* sp. nov. 13–23, lower part of Bowan Park Limestone 1½ miles north-east of Quondong; 24–29, lower part of Cliefden Caves Limestone, Fossil Hill. 13, dorsal view of incomplete cephalon of holotype SUP 23908, ×5. Note short (exsag.) inner ends of lobe *1p* and prominent mesial tubercle on occipital ring. 14, detail of antero-lateral part of cephalon to show ornamentation; holotype SUP 23908, ×10. 15, dorsal view of small pygidium of paratype SUP 23913, ×5. Note fine granulation on surface. 16, dorsal view of small, incomplete cephalon of paratype SUP 23912, showing short genal spine, ×5. 17–19, dorsal, ventral, and oblique antero-lateral views of small, incomplete cephalon of paratype SUP 23909, ×5. Note large eye, short genal spine, and fine granulation on lateral border; and on the undersurface antennular notch and anterior boss. 20–22, oblique ventral, oblique dorsal, and dorsal views of incomplete hypostome showing anterior wing and wing process, posterior wing, doublure and outer surface granulation; paratype SUP 23910; 20, ×5; 21–22, ×8. 23, dorsal view of small, incomplete cephalon of paratype SUP 23911, ×5. 24, dorsal view of large incomplete cephalon of paratype SUP 23914, ×4. Note tiny mesial tubercle on occipital ring and short (exsag.) inner end of lobe *1p*. 25, dorsal view of incomplete pygidium (possibly slightly distorted); paratype SUP 23916, ×5. 26, dorsal view of incomplete cephalon of paratype SUP 23919, ×4. Note mesial occipital tubercle and short (exsag.) inner end of lobe *1p*. 27, dorsal view of slightly distorted pygidia; paratype SUP 23917, ×4. Note more fragmentary pygidium exhibits pleurae with bluntly pointed ends. 28, ventral view of incomplete hypostome showing lateral borders and granulated median body; paratype SUP 23918, ×5. 29, dorsal view of incomplete cephalon of paratype SUP 23915, ×4. Note tiny mesial tubercle on occipital ring and short (exsag.) inner end of lobe *1p*.